OPEC Kickoff Meeting

18-20 January 2012

Danish Meteorological Institute, Copenhagen, Denmark

Contents

Executive Summary

Coastal and shelf seas provide many beneficial goods and services but also pose a risk to coastal populations. Increasingly marine environments are being disrupted by climate change and human activities. OPEC will develop and evaluate tools to help assess and manage the risks posed by man's activities to the marine environment.

The first meeting the Operational Ecology (OPEC) project was held in Copenhagen in 18th -20th January 2012, hosted by the Danish Meteorological Institute. OPEC aims to improve the quality of operational services for biogeochemical and ecological parameters and hence our ability to project the future status of European marine ecosystems. It will achieve this by delivering a suite of error quantified indicators which describe changes in ecosystem function suitable for implementation in operational centres.

The purpose of the meeting was firstly to allow the participants to get to know each other and establish lines of communication. Secondly to initiation of the work packages with an emphasis on the exchange of (technical) expertise and data between beneficiaries; understand linkages and dependencies between WP's, review of the milestones for the first phase of the project, implementation of the work plan for the first phase of the project and finally to discuss the monitoring of project progress and reporting. The meeting was very fruitful and had a lively atmosphere. There was much detailed discussion of the implementation plans for the regional model systems (WP2) and the ecological monitoring system (WP6), the key activities at the inception of the project. The rapid ecosystem assessment and seasonal forecast activities were also discussed. Finally the importance of knowledge transfer activities was stressed.

Actions

Action	Responsibility	Date of completion
D2.1 Service level agreements set up with MyOcean	Collated by J Heard (PML)	end of January 2012
Data assimilation and validation metrics workshop; 2 days in April/May	J Heard to find a suitable date	Agreed by end of February 2012
Distribution notion of hierarchy of common metrics for comment and input from the group, key questions include is the hierarchy correct and have useful metrics been identified at each level?	Icarus Allen and Momme Butenschon (PML)	March 2012
Wiki for each WP page	Martyn Atkins (PMLA)	March 2012
Benchmarking tool: distribute questions regarding list of requirement	Norman Fomferra (BC)	March 2012
Meta data for the boundary conditions and forcing functions for each region (2.2)	Tian Tian (DMI) to lead collation	Submitted to J Heard (PML) by 15 March 2012
OPEC PI profiles made available on website	J Heard to collate and publish online	Submitted to J Heard by end of February 2012. Completion by March 2012.
Establishment of a the Marine Core Service Stakeholder Group (MCSSG) by the end of March 2012	Jun She (DMI)	March 2012

Introduction

Welcome introduction from Eric Buch, Director of Operational Oceanography Division, who highlighted the growing development and importance of Operational Oceanography, to which OPEC will contribute. Icarus Allen, Project Coordinator welcomed the consortium and introduced the high level strategic and conceptual goals of the project.

Relation to Marine Policy

The OPEC project will work to provide support to a number of marine policy areas including:

The Marine Strategy Framework Directive (2008/56/EC) (MSFD) requires member states to develop strategies to achieve a healthy marine environment and make ecosystems more resilient to climate change in all European marine waters by 2020 at the latest. The strategies must contain a detailed assessment of the state of the environment, a definition of "Good Environmental Status" (GES) at regional level and the establishment of clear environmental targets and monitoring programmes.

Global Monitoring for Environment and Security (GMES)

The Marine Service delivers high quality indicators of the state of the physical environment.

Targeted applications in four mains areas:

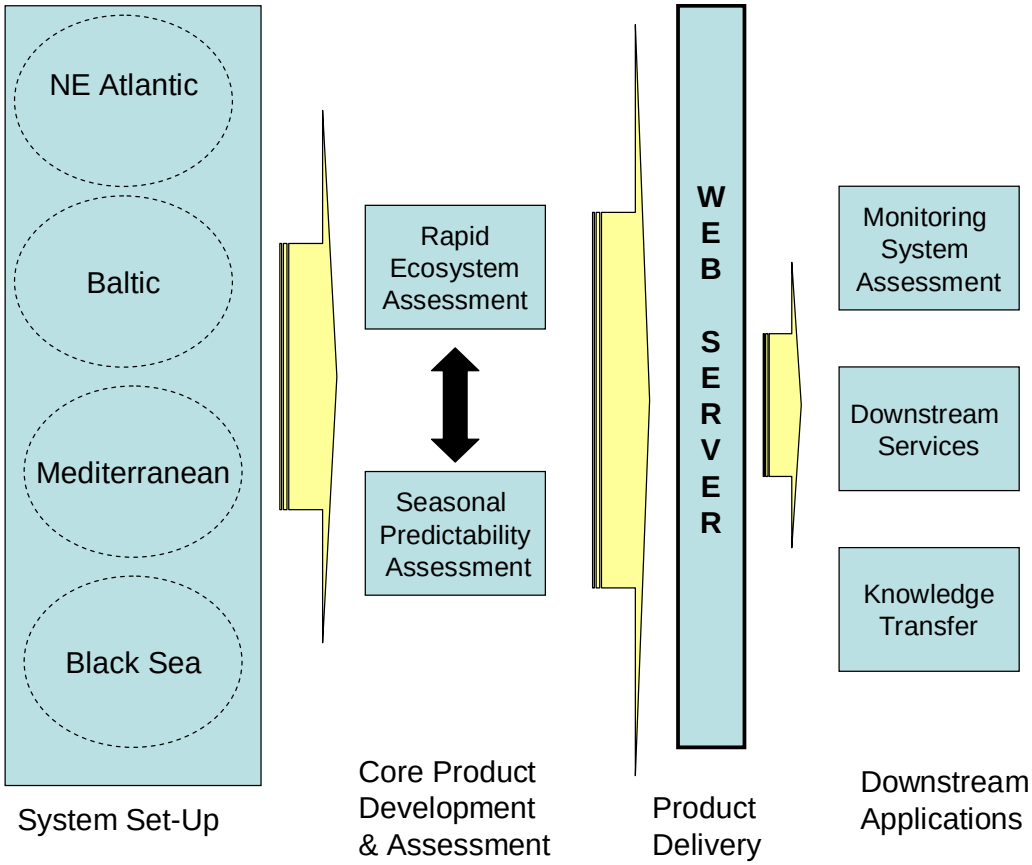
- Marine safety (e.g. marine operations, oil spill combat, ship routing, search & rescue).
- Marine resource management (e.g. fish stock management).
- Climate and seasonal forecasting (e.g. climate change monitoring, ice seasonal forecasting).
- Marine and coastal environment (e.g. ice sheet surveys, water quality, coastal activities).

OPEC key challenges

The key challenge for OPEC is to answer questions such as:

- Which time and space scales have the largest predictability?
- Where does the predictability come from?
- What are the major uncertainties, and how to estimate and reduce the uncertainties in the prediction?

Project structure and linkages



Comments from the Research Executive Agency

Paola Chiarini, the Research Executive Agency Project Office, gave a presentation highlighting key expectations from the funders, and particularly highlighted other related projects that have close links to OPEC encouraging collaboration where possible.

Project Work packages

Introductions to each WP then followed, with an overview given each WP leaders

WP1 Coordination and Management

WP Leader: Icarus Allen (PML)

The coordination objectives:

- To ensure the administrative, financial and legal management of the project
- To prepare and post-process of REA reviews from the consortium-side.
- To support in the implementation of recommendations from the REA and reviewers.

- To implement and maintain the internal project infrastructure, reporting, information exchange and email lists.
- To prepare, execute and post-process major project meetings.

WP2 Next generation model setup and benchmarking

WP Leader: Baris Salihoglu (METU)

Key objectives

- To set-up the ecological model system for the next generation GMES marine ecological service in European Seas.
- Each region will have a model system comprising a core coupled hydrodynamic-plankton model, a HTL component, a representation of the carbon chemistry and a data assimilation system.
- These will be used to perform 20 yr hindcast of each region and to benchmark model performance.

WP3 Rapid environmental assessment

WP Leader Alessandro Crisse (OGS), presentation given by Stefano Salon

Key objectives

- To provided error quantified estimates of the state of the ecosystem in the recent past to provide up to date information for environmental management.
- To make a 12 month rolling hindcast of the lower trophic components of the ecosystem of each region using the model system defined in WP2.
- To assess the skill of each indicator.
- To evaluate the contribution of data assimilations and multiple models in quantifying model uncertainty and reducing model error.

WP4 Assessing the predictability of seasonal forecast

WP Leader: George Triantafyllou (HCMR)

Key objectives

- To assess the predictability of target variables at seasonal timescales.
- To devise a strategy for assessing the predictability of key indicators at seasonal time scales.
- To assess the predictability of ECVs and key indicators for GES descriptors biodiversity (in terms of habitat) and eutrophication at seasonal timescales.
- To assess the predictability of key indicators for GES descriptors foodwebs and commercial fish at seasonal timescales.

- To make recommendations for the implementation of seasonal forecasting in operational ecology.

WP5 Assessment of ecological monitoring system and data needs for GMES ecological Service

WP Leader: Jun She (DMI)

Key objectives

- To quantitatively assess existing European coastal and regional sea observational networks for ecological parameters and establish the future data requirements.
- To record the current status of the existing ecosystem monitoring (both satellite and in situ) in each region.
- To assess the effectiveness of the current ecosystem monitoring systems in each region.
- To establish the future data requirements for the operational ecology service and make recommendation for *in situ* data collection and satellite earth observation.

WP6 Data Delivery and Downstream Services

WP Leader: Norman Fomferra (BC)

Key objectives

- To establish the technological infrastructure to disseminate OPEC products and to develop a suite of end user relevant downstream data products.
- To setup a web-based visualisation system for the dissemination of OPEC information products.
- To develop downstream, information products suitable for integration into production chains of SMEs

WP7 Knowledge Transfer

WP Leader: Jessica Heard (PML)

Key objectives

- To make cooperative links with the MCS.
- To develop strategies, frameworks and tools to transfer knowledge acquired during OPEC to user communities.
- To coordinate user inputs to OPEC through meetings of a User Group.
- To facilitate knowledge outreach using web-based tools and printed documents.
- To disseminate OPEC science achievements

WP8: Scientific Coordination

WP Leader: Icarus Allen (PML)

Key objectives

- To ensure the project meets its scientific objectives within the time and the budget limits.
- To coordinate scientific and technical reporting activities.
- To manage and monitor the evolution of the project.
- To facilitate communication with the partners and the commission.

Work package discussion sessions

Following the introduction of each WP the meeting moved onto discussion sessions to develop work plans and assign tasks per WP.

WP2 Next generation model setup and benchmarking, led by Baris Salihoglu

The main aim of the WP2 session was to identify the challenges that would be encountered during the implementation phase of the project and to establish a work plan and responsibilities. WP2 runs for the first 18 months of the project, therefore a concrete implementation plan was needed and the significant part of the first 2 days of the kick-off meeting were dedicated to this WP. Table 1 highlights the main expected challenges together with the task distribution and responsible parties is given.

Each group (NE Atlantic, Baltic, Black Sea and the Mediterranean) presented their LTL and HTL model systems. All groups showed that they have a LTL model system that would be used for OPEC purposes. The models are either validated (e.g., NE Atlantic) or validation in progress. The main challenges were identified under three main topics and equivalent breakout groups were formed to discuss the details:

i) *Model skill assessment*

The main issue identified was the assemblage of relevant data that would be used for model-data comparison. A discussion on defining the suite of target variables was occurred and included:

- DIN
- DIP
- Chl_a concentrations
- Chl_a maximum values
- bloom timing and bloom durations
- dissolved oxygen concentrations in anoxic areas
- pco2 in surface (however some partners question where carbon models were mature enough to verify pco2)

ii) *Implementation of data assimilation*

The main challenge will be the errors introduced by the satellite Chl data especially at the coastal seas. It was decided that after a brief period of data assemblage a workshop will be held to decide on the data to be used and the data assimilation schemes. For example the DMI group proposed to assimilate turbidity data instead of the Chl satellite data.

iii) *Implementation of Higher Trophic Level models*

Different groups have their HTL modules and most are not 2 way coupled with the LTL. Off line coupling can be done within 12 months although 2 way coupling may take longer (18 months). A workshop on LTL-HTL (EwE) coupling is carried out by the Cefas group. In order to use the EwE coupler that Cefas developed the Ecospace module of EwE is required.

It was decided that a workshop on data assimilation and validation metrics is warranted and would be help during month 4. Brief information on boundary conditions and forcing functions was given by the DMI group and further information will be circulated by Tian Tian. Also the links between WP2 and other work packages have been discussed. Other work packages depend heavily on WP2 and during Month 11 (annual meeting) details on progress made in WP2 and links to other work packages will be discussed.

WP2 Task/Action list
Lead for each action indicated in Red

T2.1 Assembly of boundary conditions and forcing functions M1-M3 Tian Tian (DMI)

N.E. Atlantic: Momme Butenschon (PML)
Baltic: **Tian Tian (DMI)**
Mediterranean: Paolo Lazzari **/**Kostas Tsiaras
Black Sea: **Heather Cannaby**

T2.2 Definition of a suite of target variables and a suite of metric for benchmarking them M1-M3 BC

T2.2.1 Target indicators M3-M6 Cefas Jonathan Beecham. Complete excel table and circulate
T2.2.2 Benchmarking metrics M3-M6 Momme Butenschon (PML) Notion of hierarchy to be circulated
T2.2.3 Benchmarking tool Norman Fomferra (BC): Distribution of questionnaire

T2.3 Collation of validation data M3-M12
NE Atlantic (PML, Cefas)
Baltic (DMI, DTU)
Mediterranean & Aegean (OGS, HCMR)
Black Sea (METU)

Report by May

T2.4 Implementation of the model system M1-M12 METU

T2.4.1 Baltic Sea, Zhenwen Wan (DMI) Asbjorn Christensen (DTU)

T2.4.2 NE Atlantic Momme Butenschon (PML) Jonathan Beecham (Cefas)

T2.4.3 Mediterranean HCMR Kostas/George, OGS Jpiero/Simone D.

T2.4.4 Black Sea Heather Cannaby and Bettina Fach (METU)

T2.5 Data Assimilation M1-M18 HCMR

T2.5.1 Baltic Sea M1-M12 Weiwei Fu (DMI)

T2.5.2 NE Atlantic M1-M12 Stefano Ciavatta (PML)

T2.5.3 Mediterranean Sea M1-M18 George Triantafyllou (HCMR), Gianpiero Cossarini (OGS)

T2.5.4 Black Sea M1-M18 Sinan Arkin (METU)

T2.6 Hindcast the ecosystem of each region and benchmark the target variables M1-M18 HCMR

T2.6.1 Baltic Sea M1-M18 DMI

T2.6.2 NE Atlantic M12-M18 PML

WP2.6.3 Mediterranean Sea M12-M18 OGS, HCMR

WP2.6.4 Black Sea M12-M18 METU

Report on target variables M15-M18

PML, with Cefas, DMI, DTU, OGS, HCMR, METU

- **Workshops and Milestones**
  4 Indicator definition workshop (M3) X
  Data assimilation (M4) + Validation metrics (M4)
  7 Model development complete (M11)
  8 Data assimilation implemented (M12)
  12 Benchmark simulations complete (M15)

- **Deliverables** (brief description and month of delivery)
  D2.1 Service level agreement (M1, ALL)
- **D2.2** Meta data for the boundary conditions and forcing functions for each region (M3, R, PU, Resp DMI Tian Tian)
- **D2.3** Target variables and benchmarking metrics (M9, R, PU, Resp BC PML CEFAS)
- **D2.4** Description of the coupled model for each region (M12, R, PU, resp METU + ALL)
- **D2.5** Report listing meta data for validation data for regional system (M12, R, PU, Resp METU CEFAS)
- **D2.6** Report on reanalysis hindcast skill (M18, R, PU, Resp HCMR)
- **D2.7** Hindcast of simulation results on webserver (M18, O, PU, Resp PML)
- **D2.8** Report on benchmarking the target variables (M18, R, PU, Resp METU)

Task 2.2.1 drawing up of a list of target Indicators for models.
Discussion session lead by Jonathan Beecham, Cefas

A set of criteria for inclusion of an indicator metric was drawn up to include availability from models, reliability of estimation, generality across the four regions and perceived utility and ease of explanation. Two sub-groups worked on the lower and higher trophic level indicators respectively, with the first group concentration on Essential Climate Variables (EVS) and indicators of Eutrophication, hydrographic conditions and physical components environmental diversity, the second sub-group concentrated on biological aspects of environmental diversity, food webs, commercial fish species and invasive species. The list of indicators was taken from the results of a task carried out under the Meece project ( ) but simplified.

Indicators selected for the lower trophic level modelling included:

- Winter nutrients (e.g. January-March), nitrate, phosphate
- NO3/PO4,NO3/Si ratio
- Chlorophyll-a maximum, monthly mean based
- Oxygen minimum
- Primary production
- Maximum bloom timing
- Bloom days per year
- PCO2
- Temperature + anomaly (seasonal)
- Salinity + anomaly (seasonal)
- Transport
- Water column stability (Mixed layer depth, potential energy
- Euphotic depth (90%)

Higher Trophic level indicators were populations and extents for the following species for each region:

- A small pelagic species (anchovy, herring)
- A demersal Species (Cod in Baltic and NE Atlantic)
- Additional demersal species in distinct regions (e.g. flatfish in Western NEA)
- Top predator less commercial species (sharks, seabirds) for assessing food web effects
- The Invasive Species *Mnemiopsis leidyi* (Black Sea region)

The species indicators were collated into an excel spread sheet to which information on data area, resolution and reliability can be added. This table will be made available via the OPEC website.

WP6 Data delivery and downstream services

Key Issues and Discussion Summaries

A number of important issues have been addressed during the WP6 session in order to clarify the contents of WP6 and to allow its planning of the first project year. Within this session also the benchmarking tool (WP2) has been discussed. In the following are given the key objectives of the session and the summary of its discussion.

What is WAQSS?

The WAQSS downstream service hosted and maintained at BC has been presented and its users have been briefly introduced.

During the discussion of the WAQSS-OPEC downstream services, it has been clarified, that the requirements for a WAQSS upgrade with respect to the new OPEC products are representative for other future OPEC downstream services, but the implementation of such services is out of this project's scope.

What data?

The partners have been asked to shortly explain to PMLA and BC the type, content and amount of data produced. A number of questions have been raised regarding type, content and amount of data that will be produced as output by each of the models, because a detailed knowledge about the data is one of the most important inputs for the software development performed in OPEC WP6. Therefore it was agreed that BC will distributes a questionnaire to all partners in order to collect detailed information about the data outputs. The questionnaire will ask for

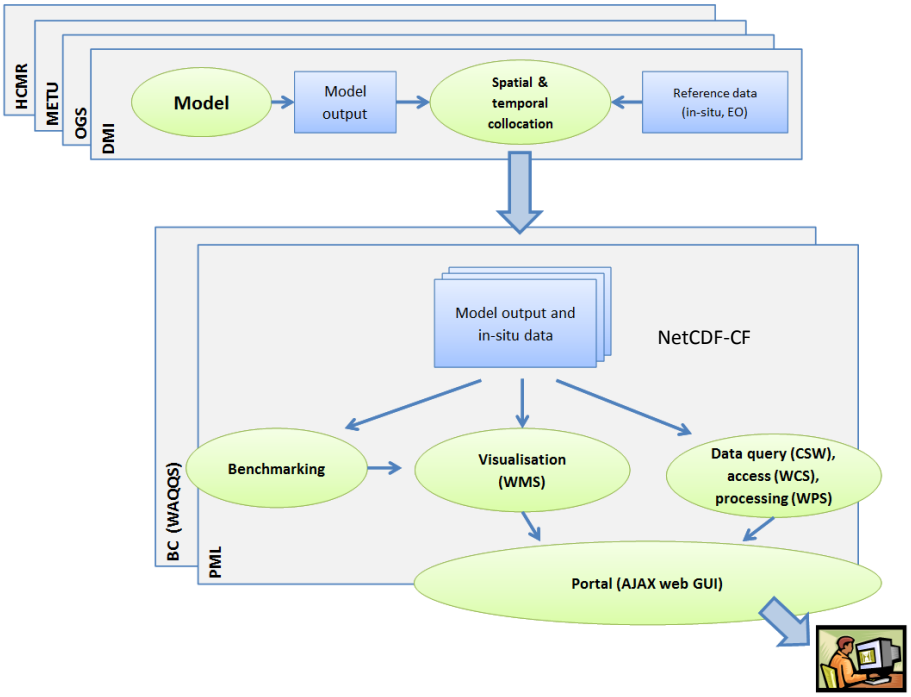
- description of contents, variable names of free-run and assimilated output;
- file formats and file tree structure;
- file sizes (of a model snapshot);
- filename convention;
- frequency (hourly, daily, monthly, annual);
- spatial, temporal and vertical resolution and
- spatial, temporal coverage (area).

All partners will also be asked to provide example files that will represent the later model output files. Regarding the various data validation and visualisation possibilities, it was also agreed that each partner will be interrogated for their needs and ideas, ideally also by providing visualisation examples.

How to realise visualisation, data access and benchmarking?

Obviously there is an important link between the software developed in WP6 and the benchmarking tool developed in T2.2.3 that hasn't been discussed in great detail in the proposal. The team identified the need to also visualise the benchmarking and validation outputs and make them accessible via the OPEC portal. This led to the question, where the benchmarking tool will be

operated, hosted, whether it is better to have a central service or if each partners should use its own copy of the tool. It turned out that a major issue is the variety of data formats (e.g. in-situ data tables, and other reference data) that the tool would need to accept. Converters would need to be developed for each input type. It was finally agreed that the best solution would be a scenario, in which each partner provides the model output in a form that already contains the reference data collocated with the model grid. The following figure illustrates this approach:



Each partner (not all are shown above) will be responsible for the spatial and temporal collocation of model outputs and reference data used for the validation. All the model outputs supplemented by reference data will be transferred to the OPEC data access and visualisation portals, hosted at PML and BC (upgrade of the WAQSS portal). The file format of the model outputs will be a NetCDF-CF whose structure and variable naming will be harmonised between all partners using the questionnaire described above.

During the requirements engineering phase of the project, partners for the model benchmarking metrics to be realised in the benchmarking tool, e.g. validation with in-situ, EO data at temporal and spatial scales, PDF.

Which programming language?

The source code that will be developed for the visualisation, benchmarking and validation may be of use for the science team as well. It should as such be programmed in a language understood by most of the team members. The majority of the team would like to see the visualisation, benchmarking and validation tools implemented in the Python programming language.

Schedule

Month 1	• Setup a developer collaboration wiki, version control system, FTP server for uploading model output example file
Month 2	• Collect example data sets • Distribute data questionnaire to all partners, collect input • Start interviews with current WAQSS users, present to the list of key indicators
Month 3	• Define common data format • Start portal design • Start interaction with WP2 on benchmarking metrics • Collect test dataset comprising model output of one year
Month 4	• Specify architecture for benchmarking and visualisation • Specify OPEC specific WAQSS features • Technology selected (Developer meeting at BC, Presentation on studies)
Month 6-9	• Benchmarking tool prototype, iterate with WP2 • Portal prototype working and ready to be reviewed by team
Month 9-12	• Benchmarking tool operable, iterate with WP3 • Portal testing & feedback collection, no more features added for M1

WP3 Rapid environmental assessment

On the base of the DoW, and of the discussion held during the WP3 workshop of the kick-off meeting (DMI, Copenhagen, 18-20 January 2012), it has been decided to perform five 12-month rolling hindcast simulations.

The definition of simulations follows:

- Run 1 at M18: simulation period from 01/06/2012 to 31/05/2013
- Run 2 at M21: simulation period from 01/09/2012 to 31/08/2013
- Run 3 at M24: simulation period from 01/12/2012 to 30/11/2013
- Run 4 at M27: simulation period from 01/03/2013 to 28/02/2014
- Run 5 at M30: simulation period from 01/06/2013 to 31/05/2014

Model systems are as defined in WP2 and Data Assimilation frequency will be set according to the regional system schemes and data availability.

The initial conditions (ICs) of Run 1 are provided by the data corresponding to the end of the 20-years hindcast (carried out in WP2); if necessary the simulation will be extended to 01/06/2012.

ICs of Runs from 2 to 5 will be derived from the previous run (to be decided before M21).

It was discussed that two consecutive runs may change (for the overlapping period) if new data are available for assimilation.

As regard the output, it was suggested to produce daily output of the indicators (the list of indicators was defined in WP2 workshop), that can be stored at the local servers for subsequent elaboration. Eventually aggregated data can be sent to partner Brockmann Consult GmbH (BC) for post-processing and visualization (following the DoW and the discussion held at the WP6 workshop).

HTL models can be run 1 way since possibly no feedbacks with LTL are present in so short term simulation.

It was reminded that all the rolling hindcast model outputs must be uploaded to BC server at M30.

All other details for the WP3 plan will be defined at the next annual meeting (M12).

WP4 Assessing the predictability of seasonal forecast

Initially we made a summary of the actions of the WP4 focusing on the experimental strategy for predictability at seasonal time scales.

The aim of this work package would be to explore the predictability of the seasonal forecast. The challenge is usually to establish the time and space scale of predictability at various trophic levels, bearing in mind that high trophic levels are most likely to have considerably longer timescales than plankton. There are actually numerous matters to consider, such as predictability from initial conditions and various meteorological forcing. We will explore the impacts of a range of initial conditions (both with and without having assimilation) and various met forcing. Predictability is going to be determined employing data and metrics defined in WP2. However, the development of a method is going to be decided by a workshop in month 18.

As the WP4 begins at M18, it will use the model-assimilation setup and implementation provided by the WP2 and WP3. The main effort will be given on the assessment of the spatial predictability at the mesoscale and the temporal predictability of month to seasons in the lower trophic level seasonal forecast as well as for food web and commercial fish descriptors.

As WP4 strongly depends on the successful model setup in different regions (Baltic Sea, NE Atlantic, Mediterranean and Black Sea), discussions emphasised on the present status of the ecosystem models and the required effort for the implementation of the assimilation schemes in each area.

WP5 Assessment of ecological monitoring system and data needs for GMES ecological Service

WP5 will quantitatively evaluate current monitoring efforts in the selected coastal areas by statistically analysing characteristic spatial and temporal scales in both the physical and ecological variables. Major input data are the 20year hindcast datasets (D2.6) and sampling schemes (meta data) of the existing monitoring networks, e.g., EuroGOOS, MyOcean, SEADATANET etc. The methodology of assessing the monitoring networks was developed in ODON and ECOOP projects.

The resources for WP5 are 15 person months, corresponding to 12.3% of the total budget. It was recognized that the data requirements for Operational Ecology have to be carefully and comprehensively specified. The WP will start from M24, hence there are no immediate concerns about the implementation plan.

WP7 Knowledge Transfer

Key activities of WP7 were discussed by the group.

T7.1 which focuses on linking with the GMES Marine Service will be led by DMI, with the progress of OPEC will be dynamically updated in MyOcean II through DMI's involvement as part of the MyOcean II Governing Board. Jun She (DMI) will lead this work and begin appropriate discussions towards the establishment of a Marine Core Service Stakeholder Group (MCSSG) by the end of March 2012. It is intended that MyOcean could feed into research work packages, through future joint workshops, the way in which long term research results will be taken up is a topic for further discussion.

7 marine regional forecasting centres will be contacted to make connections across regional seas and members of the MyOcean board and other relevant persons will be invited to form the MCS user group.

T7.2 OPEC User Community focuses on engagement with the broader user community; suggestions for appropriate members to a broader User Group for OPEC were given by meeting participants. PML will invite members to join this group shortly after the kick off meeting so that they can contribute to the early development of OPEC activities and product developments. The main objective in this task is to develop a strategy for engaging with stakeholders outside of the GMES Marine Service both policy related (e.g. EEA, ICES, HELCOM, OSPAR, Plan Bleu, and Black Sea Commission) and GMES downstream service projects (e.g. Aquamar).

It was decided that representatives from different regions would give the necessary range of input required to feed into and support OPEC's successful knowledge exchange.

Potential members include:

- Northwest European Shelf: Cefas/Defra – contact Steve Mackinson.
- Mediterranean: Ministry for Environment, Regional Agency
- Black Sea: Black Sea Commission
- European Environment Agency
- DG Environment
- ICES operational working group e.g. fisheries management, e.g. Baltic working group

Key Questions discussed with regards to engaging with the user group included:

- What are the user's needs, what does OPEC intend to offer them and what do we want to know from them?
- Are the list of products relevant, is anything missing?
- How do you like data products presented and how useful is the system that we are offering?

One of the first knowledge transfer activities will be to develop PI biographies on the KT webpages of the website to increase the visibility and outward facing profile of the project with wider stakeholders and potential users. Biographies will include a short summary of each scientist's background, their area of expertise in relation to OPEC and their key activities in the project.

OPEC will engage with other projects as appropriate, with an emphasis of FP7 projects in the environment program which target the MSFD, including MEECE, Euro BASIN and the Oceans of Tomorrow Vectors program, these activities have already begun and are ongoing, with the major vector of exchange being the co participation by OPEC participants in project meetings and workshops, examples include the February 2012 VECTORS workshop in Rome and the upcoming EUROBASIN annual meeting in May 2012.

Project Partners

1. Plymouth Marine Laboratory (PML)
2. Danmarks Meteorologiske Institut (DMI)
3. Danmarks Tekniske Universitet (DTU)
4. The Secretary Of State For Environment, Food And Rural Affairs (Cefas)
5. Istituto Nazionale Di Oceanografia E Di Geofisica Sperimentale (OGS)
6. Hellenic Centre For Marine Research (HCMR)
7. Middle East Technical University (METU)
8. PML Applications Ltd (PMLA)
9. Brockmann Consult Gmbh (BC)

Kickoff Meeting Participants

Asbjorn Christensen |DTU

Baris Salihoglu | METU | WP2 Leader

Dongchull Jeon | KORDI

George Triantafyllou | HCMR | WP4 Leader

Gianpiero Cossarini |OGS

Heather Cannaby | METU

Hyoun-Woo Kang | PML/KORDI

Icarus Allen | PML | Project Coordinator

Jessica Heard | PML | Project Manager/WP7 Leader

Jonathan Beecham

Jun She | DMI | WP5 Leader

Kostas Tsiaras | HCMR

Martyn Atkins | PMLA

Momme Butenschon | PML

Norman Fomferra | BC | WP6 Leader

Peter Walker | PML

Paola Chiarini | REA

Paolo Lazzari | OGS

Sinan Arkin | METU

Stefan Neuenfelt | DTU

Stefano Ciavatta | PML

Stefano Salon | OGS

Tian Tian | DMI

Weiwei Fu | DMI

Zhenwen Wan | DMI